

OCT 8 1925

DEPARTMENT OF COMMERCE

TECHNICAL NEWS BULLETIN

OF THE BUREAU OF STANDARDS

Subscription, 25 cents a year. Address "Superintendent of Documents,
Washington, D. C."

Washington, October, 1925—No. 102

USE OF GLUE IN COATED PAPER

For the past two years the bureau, with the cooperation of the National Association of Glue Manufacturers, has been studying the use of glue in coated papers. Results thought to be of commercial utility have been obtained, and to assist in the industrial application of these results, a demonstration was given on September 22, 23, and 24 for representatives of the glue and the paper industries.

In the manufacture of coated paper a layer of mineral matter, known as the "coating raw stock," is applied to the comparatively rough surface of the paper, a suitable adhesive being mixed with the mineral matter, and the whole, in aqueous mixture, is then spread on the paper by rapidly moving brushes. After this mixture is applied, the paper is dried, generally in festoons, and "supercalendered" to smooth the coating and give it a high gloss. Such paper is used chiefly for magazine and book printing, where a smooth, continuous surface is required to permit the use of fine screen halftones, and for lithographic and offset work.

In this country casein is employed almost exclusively as the adhesive in binding the coating, although abroad glue is more commonly used. As both the supply and quality of casein are subject to constant fluctuation, and as its continued availability for coating purposes seems rather doubtful in view of its food value, there is real interest among domestic manufacturers in finding a suitable substitute. There was little definite data available concerning

the use of glue for this purpose, and as it seemed to be the most suitable alternative adhesive for the purpose, the necessary research was undertaken to obtain such data.

Two days were given to a demonstration of the manufacture of glue-coated papers, in the bureau's paper mill. Papers were coated with the different minerals commonly used—clay, satin white, and blanc fixe—and by the use of different kinds of glue. Casein-coated paper was also made for comparison. The entire paper-making process was shown—the raw materials were mixed, beaten, made into coating raw stock, the various coatings were applied, the coated papers supercalendered, and the finished papers tested for gloss, color, and other properties. The third day was devoted to a demonstration of the printing qualities of the papers at the Government Printing Office, which has assisted throughout the research by making actual service tests of the papers produced in the course of the various experiments.

The results demonstrated were: That with proper selection of the glue used, and adaptation to local conditions and product requirements, the use of glue in coating paper requires little change in equipment and involves little change in present operating technique from procedure with casein; that the choice of various types of glue offers a considerable latitude within which local conditions can be met; and that the use of glue-bound coated paper offers no difficulty to the printer and engraver for ordinary work.

ESPARTO GRASS AS A PAPER-MAKING MATERIAL

Esparto is a perennial rushlike grass indigenous to southern Spain and the northern coast of Africa, large crops being obtained from these regions without cultivation. The fiber is extensively employed in the manufacture of paper in European countries deficient in pulp wood. In general, it is used for book and other print paper and is, therefore, comparable as regards usage to the soda pulp commonly employed in the United States.

Statements have been made that large quantities of esparto pulp could be supplied to the paper mills of this country at no higher cost than soda-wood pulp, and that the paper produced possesses strength and printing qualities superior to those obtained with soda pulp. A partially pulped stock made from esparto is now being offered for export to this country. In view of its paper-making value, comparative paper-making tests of esparto and esparto-wood pulp mixtures have been made at the bureau on both a laboratory and semicommercial scale.

For reduction of the partially cooked or semipulp material, 5 per cent of caustic soda was required with the pulping conditions usually employed in the soda-wood pulp process. For bleaching, the equivalent of 11 to 14 per cent of 35 per cent bleaching powder was necessary. The material was very dirty and required cleaning by dusting. The yield of bleached fiber from the dusted material was 57 to 63 per cent. The fibers averaged 1.7 mm. in length and 0.009 mm. in width. The small diameter as compared with the length indicates good felting quality.

The papers produced were tested for finish, as indicated by gloss, and for strength. Compared with soda and sulphite wood fiber papers, the esparto paper showed little difference in finish, and approached the sulphite papers in strength. The esparto fibers are very soft and absorbent. These characteristics are important, as it is probable that by use of esparto fibers papers can be made equal in strength to sulphite pa-

pers, and of superior softness and absorbency. Such qualities are desirable in certain printings, and in bibulous papers, such as toweling and blotting.

A detailed report of this work was published in the Paper Trade Journal for September 18, 1925.

COMBUSTION TESTS ON RAYON AND COTTON YARNS

The combustion properties of rayon as compared with cotton have been studied by the bureau in connection with the general problem of the use of rayon in underwear. This problem is extremely important to the underwear manufacturer, who is confronted with possible fire hazards and correspondingly high insurance rates.

Comparative results have been obtained on four kinds of rayon (acetate, nitrocellulose, cuprammonium, and viscose) and a 35s combed cotton yarn. Samples of fabric knitted from these yarns were also tested.

The results of the tests showed that only the samples made by the cuprammonium process were ignited more readily than cotton, and the difference in this case was very slight. Rayon, made by the viscose process, had approximately the same ignition point as cotton, rayon by the nitrocellulose process was less susceptible to ignition than cotton, while rayon made by the acetate process showed the lowest ignition point of all the samples.

The conclusion reached, stated generally, is that the fire hazard when using rayon is no greater than when using cotton, while some kinds of rayon present less hazard.

SOLE-LEATHER TESTS

A number of comparative wear tests have demonstrated that ordinary belting leather made up into a shoe sole wears better than sole leather. Both leathers are vegetable tanned, but the former is more pliable and contains about 12 per cent grease, as compared with 3 per cent in the latter.

Further experiments have been completed to determine the effect on the

durability of washing material and grease has been the same. The resins used so far as per cent. T. brought grease and m. yield m. instead of leather. A qu. property under these will give advantage service to dem. SEASON

A report to the year publication has been committed on Under this study. An effort to build to the held up early w. sooner spring previous

The major substance for if the structure movement during undoubted from progress ties of

durability of ordinary sole leather of washing out some of the tanning material and then stuffing the leather with greases. Leather prepared in this way has been tested in comparison with the same type of leather before treatment. The results show that the so-called curried sole leather wears approximately 20 per cent longer than the regular product. This increased wear is probably brought about by the action of the grease which makes the leather softer and more pliable. Such a sole will yield more readily to sharp objects instead of wearing away as does the firmer leather.

A quantity of leather with similar properties is produced in this country under the name of flexible sole leather. These results indicate that such leather will give longer life and may be used to advantage by ordinary civilians if the service conditions are not severe enough to demand a firm leather.

SEASONAL OPERATION IN THE CONSTRUCTION INDUSTRIES

A report of the results of the movement to stabilize building activity during the year, covering the period since the publication of the report in August, 1924, has been prepared for submission to the committee of the President's Conference on Unemployment which has sponsored this study.

An examination of statistics relating to building contracts awarded and movements of various building materials leads to the conclusion that building activity held up better during the late fall and early winter of 1924 and got under way sooner during the late winter and early spring of 1925 than during the three previous years.

The report indicates that, while no major revolution has yet been effected, substantial improvement may be looked for if the subject is kept before the construction industries and the public. The movement has made undeniable progress during a number of years, and would undoubtedly continue to make headway from purely economic causes, but its progress can be hastened by the activities of the division of building and hous-

ing and the cooperation of private organizations with which it has contacts.

THE DETERMINATION OF CALCIUM AND MAGNESIUM HYDROXIDES IN HYDRATED LIME

Trouble with lime plaster is comparatively rare, but when it does occur, one of the factors to which it is sometimes attributed is the slow hydration of the magnesium oxide content of the hydrated lime employed.

It is well known that magnesium oxide, after heating to the temperatures existing in the average limekiln, hydrates, or combines with water, only with extreme slowness. This combination may easily take place after the lime has been used in a mortar or plaster and after an appreciable interval of time. Since the hydration is accompanied by a considerable expansion, more or less serious results may be expected if it does occur.

In order to study this problem more fully, the bureau found it necessary to develop a method of analysis which would give some information not obtainable by ordinary chemical analysis, namely, the condition of the magnesium and calcium oxide content of the lime individually. The usual chemical analysis gives the total amount of combined water, for example, but does not give any information as to whether it occurs as calcium or as magnesium hydroxide. However, if the troubles which have sometimes been experienced are to be definitely attributed to the magnesium oxide, more must be known on this point. A method, which it is believed may be employed, and which was recently developed at the bureau, consists in heating a sample of the hydrate or mortar in a closed system, at definite increments of temperature, for periods of 20 minutes. The loss in weight of the sample is determined after each heating period. Since magnesium hydroxide loses its water at a lower temperature than does calcium hydroxide, if these data are plotted in the form of a curve (temperature against loss in weight), the amount of water present in magnesium hydroxide and that as calcium hydroxide can readily be estimated.

Several runs have been made using this method on samples of commercial limes high in magnesium. In every case investigated the calcium is almost completely combined, either as hydroxide or as carbonate. In hydrates newly received from the manufacturer the percentage of magnesium hydroxide seems to be very small, usually not more than 15 or 20 per cent of the total magnesia content. In those samples which remained for some time in the laboratory, however, the percentage was considerably greater, showing that in time the magnesia does hydrate.

Thus far only hydrates have been studied. In order definitely to relate the magnesia content of a lime to its effect on the mortar or plaster more work must be done, since many of the hydrates studied, while having very low contents of magnesium hydroxide, have been used satisfactorily in practice.

BLENDED CEMENTS

To secure economical construction of mass concrete structures built in localities where the transportation of materials is expensive, cements in combination with other materials, such as sand, are often used as the cementing constituent of the concrete. Combinations of this nature are usually prepared by grinding the two materials together for a given period of time or to a definite degree of fineness. The resulting mixtures are quite generally known as blended cements.

During the past 10 or 12 years the bureau has been carrying on studies of blended cements from the standpoint of the durability and strength of mortars and concrete made from them. There is now being prepared a report of the work on various lots of blended cements, giving the strength results at different ages up to and including some 11 and 12 year curing periods.

The major portion of the work is based on strength tests made on a number of concrete, mortar, and neat cement specimens prepared from three blended cements used by the United States Bureau of Reclamation for some of its western projects. The concrete speci-

mens were 8 by 16 inch cylinders which had been stored out of doors exposed to the weather. Tensile specimens consisted of both neat cement and standard sand mortars cured under both water and inside air storage. Two-inch cubes made of standard sand mortar and kept in air storage were used for the compressive tests of the mortars. All the specimens were prepared at the bureau, and parallel concrete specimens were made from a Portland cement. The latter was not from any of the lots of cements used in the preparation of the blends; nevertheless, specimens made from it were of interest in comparing the strength of the different concretes over the period covered by the tests.

Before testing the concretes at the several ages, the effects of exposure to weather conditions were determined by noting the appearance of the surface of the test cylinders. Concrete from one of the blended cements had withstood satisfactorily the effects of weathering, while some of the specimens of the other two blends showed considerable lack of durability.

The results of the strength tests show no constant relation between the tensile strength of the neat cements or mortars and the compressive strengths of the concretes. After considering the range in strengths of the concretes prepared from the blended cements and after studying the strength of mortars of the corresponding ages it is apparent that if definite information is to be secured as to the relative merits and behavior of these materials, as well as the effect of varying the proportions, laboratory tests must be made of the materials in the several proportions which would be used in actual construction.

PROBLEMS RELATING TO SAGGERS

Saggers are refractory or heat-resistant containers which are used to protect pottery, tile, and similar delicate materials from fire, gases, and other deleterious substances present in the kiln during burning. They also provide a convenient means of support for the ware.

The sh
annually
of the Ur
The bure
assist the
present sa
by condu
has for it
in the lif
a study o
clays, a c
properties
showing
which the

Sample
sent an
important
country,
tion. In
clays acc
following
mined: W
linear sh
rupture,
havior at
dunting
graphic a

The ch
variation
as indica
tent, fro
total of
The ratio
shows tw
uncombin
cent, whi
designated
rational c
found th
inversely
content t
each of t
clays hav
softening

In the
their high
the 1,270
showed
burned at
vitrificati
ume shri
clays to h
A prelimi
into four

The short life of the clay saggars is annually costing the ceramic industry of the United States millions of dollars. The bureau is therefore attempting to assist the manufacturer who finds his present sagger costs discouragingly high, by conducting an investigation which has for its ultimate purpose an increase in the life of the sagger. This involves a study of the properties of the sagger clays, a classification according to these properties, and the preparation of a map showing the location of the mines from which these clays are obtained.

Samples of 51 different clays, representing as well as could be judged all the important clay-mining districts of the country, are included in the investigation. In order to classify the sagger clays according to their properties, the following properties have been determined: Water of plasticity, volume and linear shrinkage, porosity, modulus of rupture, softening point, burning behavior at five different temperatures, and dunting. Also, chemical and petrographic analyses have been made.

The chemical analyses show a wide variation in the composition of the clays, as indicated by the range in SiO_2 content, from 49 to 78 per cent, and the total of flux from 1.5 to 10 per cent. The rational composition of the clays shows two-thirds of them to contain uncombined quartz in excess of 20 per cent, which clays would, therefore, be designated as siliceous. Comparing the rational compositions of the clays it was found that the softening point varied inversely as the ratio of the average flux content to the average clay content in each of the four groups into which the clays have been classified according to softening point.

In the burning tests 15 clays reached their highest transverse strength during the $1,270^\circ \text{C}$. burn; and 33 of the clays showed greater strength after being burned at $1,310^\circ \text{C}$., due to approaching vitrification, although the porosity, volume shrinkage, or both indicate the clays to be overfired at this temperature. A preliminary classification of the clays into four groups has been made accord-

ing to the increasing average modulus of rupture and decreasing average porosity. The clays comprising a fifth group have undesirable burning properties.

Cooperation by manufacturers permitted the repeated burning of a number of clays under actual plant conditions. The data collected indicate that some definite changes take place in the clays when repeatedly burned at constant temperatures. The most pronounced of these were found to be gradual changes in porosity, volume, and modulus, of rupture which are accompanied by the formation of increasing amounts of mullite and glass.

No definite relation was found to exist between the results obtained from the dunting test and other physical or chemical properties available. The uncombined quartz, although undoubtedly affecting the resistance of clay saggars to thermal shock, can not be regarded as the sole cause of failure, for the results indicate that other factors affect the resistance of these clay saggars to thermal shock.

The first progress report on this investigation has been prepared for publication in an early issue of the Journal of the American Ceramic Society.

REACTIVATION OF ELECTRON TUBES

Electron tubes in radio receiving sets eventually lose their sensitivity. This sometimes progresses to the point where the receiving set operates very poorly or not at all, even though the tube filament is not burned out. The user of the set frequently confuses this condition with that due to an exhausted B battery. If the tubes are of the thoriated tungsten (X-L) filament type, they can usually be rejuvenated by a simple process, and made to serve as well as new tubes in the receiving set.

It happens that most of the tubes now used are of the thoriated tungsten type, and it therefore becomes of quite general interest for the public to know how to secure the full life of their electron tubes. The WD-11 and WD-12 type of tubes are the only ones extensively used which can not be reactivated. In these tubes the source of the electrons

is a coating of certain oxides on the surface of the filament, and when this has been used up no process can renew it. The thoriated tungsten filaments, however, used in most of the various other types of tubes, contain the oxide of thorium throughout the whole mass of the tungsten filament, this oxide having been originally put in incandescent lamps to keep the filaments from being too fragile. The filaments are given a treatment which produces a layer of atoms of thorium on the surface of the tungsten, and this thorium, which is radioactive, emits electrons much more copiously than the tungsten would. After long use, or after burning the filament too brightly, the layer of thorium atoms is evaporated off, and so few electrons are then emitted that the tube does not function properly. Reactivation is a process which boils additional thorium atoms out of the interior of the tungsten filament and forms a new layer of thorium atoms on the surface.

The thoriated filament was developed by the General Electric Co., which has also developed the methods of reactivating tubes of this type. The Bureau of Standards has found that the reactivation process is quite successful, and frequently makes a wonderful difference in the results obtained with a receiving set. The process is essentially the operation of the filament for a very brief interval at a specified high voltage (called "flashing"), followed by a lower voltage for a longer time (called "aging"), all of this with no grid or plate voltage. The flashing reduces some of the thorium oxide in the wire to thorium, and the aging forms the required surface layer. The following schedule of these operations is the result of extensive experience of the Radio Corporation of America, and is published here by courtesy of that company.

FLASHING

Radiotron	Fila- ment voltage	Time
	<i>Volts</i>	
UX and UV-199 ----	10	30 Sec.
UX and UV-201-A --	15	1 Min.
UX-120 -----	10	Do.

AGING

UX and UV-199 ----	4.5	10 Min.
UX and UV-201-A --	7.5	Do.
UX-120 -----	4.5	Do.

Exactly the same procedures apply for C and CX tubes as for the UX tubes of corresponding number; thus, C and CX-299 correspond to U and UX-199; C and CX-301-A to U and UX-201-A; and CX-220 to UX-120.

In carrying out this schedule it is absolutely essential to have a voltmeter of a good degree of accuracy and to use a watch. No grid or plate voltages are used. Either alternating or direct current may be used for heating the filaments.

It is important that reactivation not be attempted until the tube user has assured himself that the tubes actually need this treatment; that is, he should make certain that his batteries are not run down, and that other parts of the receiving set are in proper order. The schedule above should be followed with great care. The process is useful only for the thoriated tungsten filament type of tubes.

The apparatus necessary for carrying out the process is simple. The filament is connected to the necessary source of voltage, nothing being connected to the grid and plate. A voltmeter is connected across the filament terminals. If alternating current is available the

Technical

page 6

4

7

4

Spec
omiss
these
tages

ERRATUM

Technical News Bulletin of the Bureau of Standards
No. 102 - October, 1925

page 6, in table under "Aging":

4 5		4.5
7 5	should be	7.5
4.5		4.5

Special attention is called to this because omission of the decimal points in the printing of these numbers might lead many persons to apply voltages which would destroy their radio tubes.

2.
n.

ELECTRICAL
RA

not
the
The
with
only
type

ing
ent
of
the
on-
als.

the

During the
has been cal

source of voltage can be a small transformer, such as those for running doorbells or electric toys. The voltage tap nearest the voltage specified should be selected and a rheostat in series with the filament used to adjust to the exact voltage. The voltmeter must be one for alternating current.

If alternating current and a transformer are not available dry batteries or storage batteries may be used as a source of voltage. A single dry cell when new will furnish approximately 1.5 volts. A rheostat should be connected in series to give the exact filament terminal voltage as indicated on a direct-current voltmeter. There are several manufacturing companies that advertise tube reactivators at varying prices. Radio dealers are beginning to give tube reactivation service.

ELECTRICAL INTERFERENCE WITH RADIO RECEPTION

In some localities radio reception is seriously disturbed by interference arising from electrical apparatus in the vicinity. Part of the disturbance from electrical devices is practically inevitable, and, like atmospheric disturbances, must be regarded as one of the inherent limitations of radio reception. Some electrical devices when in perfect working order cause disturbances of this kind, while others cause interference because of their faulty operation. The only general remedy for electrical interference is cooperative effort on the part of users of radio, users and owners of the electrical sources of disturbance, and distributors of electrical power, to reduce or eliminate the causes of the trouble. In many cases it is possible to provide filters, shields, chokes, etc., either at the source of disturbance or at the receiving set, which do much to relieve the difficulties.

A brief outline of the sources of such interference and the methods usually used in mitigation is given in Letter Circular No. 182, copies of which may be obtained upon application to the Bureau of Standards, Washington, D. C.

GASOLINE ECONOMIZERS

During the past few years the bureau has been called upon quite often to test

so-called "gasoline economizers" for use on automobile engines. Because large numbers of these devices are undoubtedly being sold, and because there seems to be a lack of knowledge on the part of the public concerning this subject, it appears desirable to explain just what these "economizers" really accomplish.

The type of device referred to is that which, in one way or another, admits air to the intake system above the throttle. It is usually claimed that increased power and economy result from the use of such devices. To support these claims the salesman may install the device, and, with the engine idling, place his hand over the hole through which air enters the economizer and show that by thus rendering the device inoperative the speed of the engine is much reduced. This appears to justify the claim of increased power. In some instances it may be possible to drive over a certain course both with and without the device and show definitely higher mileage per gallon of gasoline under the former conditions. More often, however, before making the economy test, the demonstrator will lean the mixture. He explains that this is made possible by an improvement in vaporization or some other effect produced by using the "economizer."

At first glance these tests would appear to demonstrate conclusively the worth of the product under consideration. A little thought will show that they do nothing of the sort. In the case first mentioned, where the throttle is nearly closed, the area of throttle opening through which the charge passes from the carburetor to the manifold is rather small and in comparison with it the area of the hole through which the "gasoline saver" admits air to the manifold is appreciable. With the throttle in this position, therefore, the device materially increases the amount of charge that enters the engine, and ordinarily it increases the power, because in most cases the original mixture can be leaned considerably before the decrease in power produced per unit weight of charge is equal to the amount by which

the charge is increased. Exactly the same result could, of course, be obtained by opening the throttle slightly and decreasing the rate of fuel flow. The observer of a test of this sort is likely to conclude from the apparent increase in power at nearly closed throttle that there will be a proportional increase in power at full throttle. At full throttle, however, the area of opening into the "gasoline saver" is negligible in comparison with the area of throttle opening, and the increase in power is likewise negligible. "Economizers" of this type merely dilute the charge. If the original mixture is too rich, as is sometimes the case, the additional air is desirable, otherwise not. Usually the influence of such devices in the normal operating range of the engine is comparatively slight, and in case there is any improvement in operation it is due to the additional air and not to any inherent virtue in the "economizer" through which the air is admitted.

Even in those cases where the additional air results in improved operation it seems unfortunate that the public should be led to believe that this is brought about by using the "economizer." Such a conclusion tends to discredit the original equipment of the car which may be of good design and capable of excellent performance when properly adjusted.

PUBLICATIONS OF THE BUREAU OF STANDARDS RELEASED DURING SEPTEMBER

Scientific Papers

- S510. Effect of wear on the magnetic properties and tensile strength of steel wire; Raymond L. Sanford, Walter L. Cheney, and James M. Barry. Price, 5 cents.

Technologic Papers

- T292. Relative merits of cotton and jute cement sacks; Robert J. Morris. Price, 10 cents.

Circulars

- C275. United States Government Master Specification for builders' hardware. Price, 15 cents.

- C276. Motor-vehicle headlighting. Price, 20 cents.

Miscellaneous Publications

- M65. National directory of commodity specifications. Price, \$1.25.
Simplified Practice Recommendations
Elimination of Waste
R1. Paving bricks, Fourth revision. Price, 5 cents.

These publications can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices given above.

OUTSIDE PUBLICATIONS

- Storage batteries, G. W. Vinal, *Journal Optical Society of America and Review of Scientific Instruments*, vol. 11, p. 263; September, 1925.
Multiple electron transitions and prime spectral terms, A. E. Ruark, *Journal Optical Society of America and Review of Scientific Instruments*, vol. 11, p. 199; September, 1925.
Active metallurgical research, H. W. Gillett, *Iron Age*, vol. 116, p. 536; August 27, 1925.
The failure of thermocouple protection tubes in glass-melting furnaces, H. Insley, *Journal American Ceramic Society*, vol. 8, No. 9; September, 1925.
Fine grinding of cement increase strength of concrete, M. Temin and W. H. Sligh, *Concrete*; September, 1925.
Close water control important in alumina cement concretes, P. H. Bates, *Engineering News-Record*; September 17, 1925.
The adhesion of gypsum plaster to various backings, J. P. C. Peter, *American Architect*, vol. 78, p. 227; September 9, 1925.
The effect of stirring on the 'time of set of mechanically mixed gypsum plaster, L. E. Smith, *Rock Products*; August 22, 1925.
Leather work of the Bureau of Standards, R. C. Bowker, *American Shoe making*; September 26, 1925; *Leather Manufacturer*; September, 1925.
Cordage work of the Bureau of Standards, C. W. Schoffstall, *the Cord Age*; September, 1925.
Hydrogen ion concentration in the paper mill, M. B. Shaw, *Paper Trade Journal*, vol. 81, p. 59; September 3, 1925.

